

Doppler-Guided Haemorrhoidal Artery Ligation (HAL) and its Effectiveness in Achieving Patient Satisfaction in Haemorrhoidal Bleeding

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Abstract

Background: Doppler-guided Haemorrhoid Artery Ligation (HAL) of the terminal branches of the superior haemorrhoidal artery is an increasingly popular technique in haemorrhoid management.

Objectives: The aim was to assess the role of Doppler HAL in haemorrhoid management, patient outcomes and satisfaction.

Materials and Methods: The study was a prospective case series, analysed retrospectively. Seventy-eight consecutive patients undergoing Doppler HAL for Grade III and IV haemorrhoids at a single metropolitan private hospital in Sydney, Australia were included in the study. A modified proctoscope housing a Doppler transducer was used to sequentially suture ligate the haemorrhoidal arteries. The authors report our preliminary experience with regards to post-operative symptoms, re-intervention requirements and overall patient satisfaction with the procedure and symptom management.

Results: The predominant pre-operative symptom was haemorrhoidal bleeding. First follow-up was four weeks post-procedure. The minimum follow-up was at 1, 3 and 18 months. First follow-up showed 55 patients had no bleeding at all (71%), with most patients also having no pain (78%). Six patients underwent further intervention (8%). Short to medium term follow-up at 3 to 18 months showed 65 patients were satisfied with the procedure (84%). Of those surveyed beyond 18 months, 66 patients had no bleeding or bleeding less than once per month (89%), and satisfaction scores were high at 88%. Further intervention was reported in 24 patients (32%). Only a total of 4 patients (5%) progressed to requiring a haemorrhoidectomy.

Conclusion: Doppler-guided HAL is safe and effective in treating symptomatic haemorrhoids. It has an acceptable progression to further intervention and importantly provides high patient satisfaction in the immediate, short and medium post-operative follow-up period.

Keywords

Haemorrhoids; Haemorrhoid surgery; Haemorrhoid artery ligation; Transanal haemorrhoid dearterialization; Patient outcomes

Introduction

Haemorrhoids are a common condition worldwide although data regarding prevalence in Australia is scarce. Previous primary care surveys indicate 4.4% of patients have had haemorrhoidal surgery [1]. However, data from similar populations such as the USA and UK indicate the prevalence could be much higher, between 4 and 36 [2-4]. The Australian Bureau of Statistics recorded 50,000 hospital interactions relating to a principal diagnosis of haemorrhoids in 2013-2014, and this has an obvious impact on the healthcare system [5-7]. The initial approach to suspected haemorrhoids should exclude other causes of haematochezia, particularly malignancy. Subsequently, attempts usually focus on conservative management or minimally invasive techniques such as Rubber Band Ligation (RBL), which is widely accepted as being effective in treating first and second degree haemorrhoids. An issue with RBL is that there is often a requirement for multiple episodes of treatment. Another conventional approach is Milligan-Morgan haemorrhoidectomy. This is often utilised for third- and fourth-degree haemorrhoids, or second-degree haemorrhoids that have been unsuccessfully treated by other less invasive means. Unfortunately, the Milligan-Morgan approach is associated with significant pain and potential complications such as bleeding, sepsis, anal stenosis, sphincter damage and incontinence.

A less invasive technique gaining popularity is Doppler-guided Haemorrhoid Artery Ligation (Doppler HAL). There have been several case series published, although only one in an Australian setting [8]. It was introduced by a Japanese surgeon in 1995 based on the

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assumption that artery ligation should result in shrinkage of the haemorrhoidal mass [9]. This technique uses a Doppler transducer to identify and ligate the terminal branches of the superior rectal artery. A key goal in haemorrhoid management is patient satisfaction rather than complete resolution of symptoms, an important delineating factor which has precedence in the literature [10].

Furthermore, an important principle in patient care is to provide the safest care with optimal outcome in the least invasive manner. Doppler HAL is a day-only procedure which aims to provide an option between non-surgical conservative management and significant anorectal surgery. It is a relatively time and resources efficient procedure compared a haemorrhoidectomy. The optimal patient for Doppler HAL is not well established, and whilst previous studies have predominantly reported on grade II-III patients, this study focused on higher grade patients that have failed previous RBL but wish to avoid a significantly more invasive procedure. The authors report their experience with the Doppler HAL technique and ongoing satisfaction from initial post-operative review to 18 months in an Australian setting.

Materials and Methods

This study was a prospective case series, analysed retrospectively, for Doppler HAL performed by a single surgeon. The data collected at the initial consultation prior to initial surgery, at the primary follow up and then either an annual telephone follow up. If any further follow up or intervention was required by the surgeon this was also used as an additional point of review. The primary surgeon discussed the risks, benefits and alternative management. Consent was obtained from all patients regarding data collection prior to enrolment. Seventy-eight consecutive patients undergoing Doppler HAL for Grade III and IV were included in the study. Patients were operated on between July 2011 to March 2015 by a single surgeon in a single center. Pre-operatively, each patient was thoroughly assessed to exclude other causes of rectal bleeding such as rectal cancer, or anal fissure. The main presenting symptom in all patients included in this study was haemorrhoidal bleeding. Data was analysed using a variety of statistical methods in IBM SPSS Statistics for Mac OSX, Version 23.0.

First post-operative clinical follow-up was scheduled for 4 weeks post-operatively in the surgeons consulting rooms. Further appointments were only made if necessary. If no further appointments occurred, ongoing follow-up was conducted via a telephone survey at 3 and 18 months. The follow up survey consisted of questions to assess recurrence of haemorrhoidal bleeding, associated pain and patient satisfaction. The latest medium term follow-up was conducted in January and September 2016. The authors plan to conduct long term follow up as greater patient numbers progress beyond 2 and 3 years, however, this is not included in this current study.

The aims of follow up were to assess post-operative symptoms, re-intervention if any, and overall patient satisfaction with the procedure process and symptom management. All follow up, whether it was via the telephone survey, in-person review or at subsequent re-intervention, was recorded in the database. Any major negative outcomes such as major post-operative bleeding and sepsis were recorded. Symptoms recorded included frequency of haemorrhoid related pain and degree of any haemorrhoidal bleeding. Any re-intervention was recorded including the time from primary intervention and type of subsequent intervention. Bleeding was classified into no bleeding at all, occasional bleeding less than once per month, some bleeding once per fortnight and persistent bleeding with no significant improvement. Pain was classified as no pain at all, occasional pain less than once per month, some pain once per fortnight and persistent pain with no significant improvement. Patient satisfaction was assessed using the presentation of a standardised set of questions. These enquired about satisfaction (yes/no) with regards to: the procedure on the day, post-operative care, resolution of symptoms, and overall satisfaction with the procedure. Follow up beyond 6 months simply asked whether they were satisfied with the current outcome of the procedure.

Operative Technique

A modified proctoscope housing a Doppler transducer was used to locate the arteries (THD Sonda Doppler Slide MO, Medical Specialties, Italy). The proctoscope was equipped with a light source and a window through which suture ligation can be performed. The Doppler HAL proctoscope was inserted after lubricating the anal canal with a xylocaine-based lubricating gel. Haemorrhoidal arteries were sequentially located by rotating HAL proctoscope. Once identified, each vessel was ligated by placing a figure-of-eight suture around the vessel. A range of six to nine vessels were ligated. Absence of Doppler sounds distal to the sutures was used to confirm adequate ligation of the artery. If further Doppler sounds were present a second suture was placed. A long needle holder is used in combination with an absorbable 2/0 vicryl suture.

Intra-operatively, patients received propofol, midazolam and fentanyl as anaesthetic agents, as well as prophylactic IV metronidazole, unless specifically contraindicated due to allergy or adverse reaction. All patients were treated in lithotomy position.

Results

A total of 78 consecutive patients underwent Doppler HAL patients between July 2011 and May 2015. The mean age was 53 years (range 29 to 86 years). All of the patients had already attempted RBL (78/78; 100%). There were 74 patients with grade III haemorrhoids, and 4 with grade IV. Given the low number of grade IV patients they were analysed as a single cohort. Pre-operative symptoms were most commonly bleeding, pain and/or itch. Significant bleeding was the most common complaint with 18 patients reporting frequent bleeding with almost every bowel motion (18/78; 23%). A further 24 patients had frequent bleeding every fortnight (24/78; 31%). Pain was less common with only 8 patients reporting some form of pain symptoms (8/78; 10%).

When Doppler HAL was first performed, the first 18 patients were kept overnight for observation, however, following the initial positive outcomes subsequent HALs performed from January 2013 were day-only procedures. Multiple non-parametric tests including Spearman and Kendall's tau showed no statistically significant correlation between post-operative symptoms at first review, repeat procedure or satisfaction in any domain, indicating no significant ongoing learning curve.

Mean total follow-up length was 122 weeks (range 4 to 238 weeks). All seventy-eight patients had at least one recorded post-operative encounter (78/78; 100%), the median first follow-up occurring 5 weeks post-procedure (range 1 to 100 weeks). At the first follow-up 55 patients had no bleeding at all (55/78; 71%), 12 patients had occasional bleeding but less than once per month (12/78; 15%), 8 had some bleeding approximately once per fortnight (8/78; 10%), and 3 had persistent haemorrhoidal bleeding (3/78; 4%). Most patients had no pain at the first follow up (61/78; 78%). Of the remaining patients 15 had occasional pain <1/month (15/78; 19%), whilst only 2 had some pain ~1/fortnight (2/78; 3%). No patients had persistent pain. (Table 1) highlights these results for symptoms of bleeding and pain at the first follow up.

Running Spearman's rank-order correlation showed no statistically significant correlation between bleeding and pain ($r_s = 0.167, P=0.144$). Figure 1 shows the combination of patients with symptoms of pain and bleeding. After the first follow-up, six of the patients underwent re-intervention (6/78; 8%. See Table 2 of these (3/6; 50%) had repeat Doppler HAL and the other three had RBL (3/6; 50%).

At short to medium term follow-up (3 months to 18 months) 1 patient (1/78; 4%) was lost to follow-up, 47 patients (47/77; 64%) were completely satisfied with HAL and experienced no further bleeding. 18 patients (18/77; 23%) experienced occasional bleeding but were still satisfied with HAL, hence making a total of 65 patients (65/77; 84%) being satisfied with the procedure. Two patients (2/77; 3%) required Milligan-Morgan haemorrhoidectomy due to persistent bleeding. Three patients who had some bleeding improved after RBL, and three patients had repeat HAL. The total re-intervention rate in the medium term was 17% (13/77).

	First follow up		Medium term follow up (>18 months)	
	Frequency	Percent	Frequency	Percent
No pain	61	78%	62	84%
Occasional pain(<1/month)	15	19%	1	1%
Some pain(~1/fortnight)	2	3%	0	0%
Persistent pain all the time	0	0%	0	0%
Missing			11	15%
Lost to follow up			2	3%
Total	78	100%	76	

	Frequency	Percent	Frequency	Percent
No bleeding	55	71%	59	80%
Occasional bleeding (<1/month)	12	15%	7	9%
Some bleeding (~1/fortnight)	8	10%	7	9%
Persistent bleeding with every bowel motion	3	4%	1	1%
Lost to follow up			2	
Total	78	100%	76	

Table1: Symptoms of pain and bleeding reported at the first follow up and beyond 18months following Doppler HAL in-case series of 78 patients.

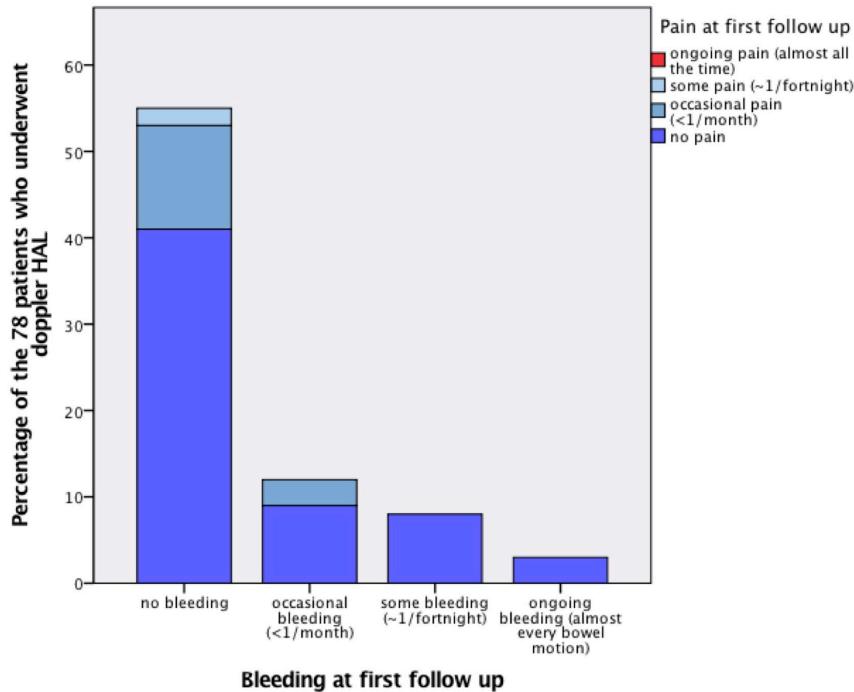


Figure 1: Combination of symptoms of pain and bleeding at first follow-up subsequent to Doppler HAL in case series of 78 patients (original figure)

The most recent telephone surveys were conducted between January and September 2016. At these points medium-term results (minimum >18 months post-op) regarding any re-intervention, symptoms and patient satisfaction were obtained. At the most recent survey a total of two patients had been lost to follow up (2/78; 3%). A further two patients were less than 18 months post-op (2/76; 3%), and where thus ineligible to be included. Of the remaining 74 patients only one (1/74; 1%) had ongoing frequent bleeding (almost every motion) and seven had ongoing bleeding approximately once per fortnight (7/74; 9%). Conversely, the remainder had no bleeding or bleeding less than once per month (66/74; 89%).

Beyond 18 months a total of 24 patients were reported to have undergone some form of re-intervention (24/74; 32%). Of these 13 patients required re-intervention within 12 months of their operation. The mean time between primary operation and time of re-

intervention was 49 weeks (range 2 to 114 weeks). All of the grade IV patients who were able to be followed up (n=3) underwent some form of re-intervention. However, only one grade IV patient progressed to a Milligan-Morgan hemorrhoidectomy. As a cohort, re-intervention type was most frequently RBL (9/74; 12%) or repeat Doppler HAL (7/74; 9%). The remaining re-intervention rates are shown in (Table 2). Final satisfaction scores showed 65 patients were satisfied whilst 9 were not satisfied (65/74; 88%, and 9/74; 12% respectively). Satisfaction among the grade IV patients was 67% (2/3) despite the 100% (3/3) re-intervention rate.

Discussion and Limitations

Doppler HAL is a safe and effective option for haemorrhoid management with excellent long term patient satisfaction (88% satisfied with the procedure). It has low post-operative bleeding and

	First follow up		Medium term follow up (>18 months)	
	Frequency	Percent	Frequency	Percent
RBL post-op	3	4%	9	12%
Repeat HAL	3	4%	7	9%
Milligan-Morgan	0	0%	2	3%
Combination of RBL and HAL	0	0%	4	5%
Combination HAL and/or RBL and Milligan-Morgan	0	0%	2	3%
<i>Total re-interventions</i>	6	8%	24	32%
<i>No re-intervention recorded</i>	72	92%	50	68%
Total	78		74	

Table 2: Re-intervention at the first follow up and beyond 18 months following Doppler HAL in case series of 78 patients

discomfort (89% no bleeding or bleeding less than once per month; 97% no pain or pain less than once per month) and a comparable or better medium term re-intervention rate to rubber band ligation (3-18 month re-intervention rate 17%).

With the large numbers of haemorrhoids seen in Western world [2-4] and an established short operating time in Australia and abroad [6,9], Doppler HAL has been established by a recent systematic review of a broad range of surgical interventions for haemorrhoids to be 'a safe, quick and easy initial surgical option [11]. In addition to this there are several dedicated series on HAL which show good results since the first paper by Morinaga et al. [8-10,12-17]. However, whilst there is an acceptance of it as a viable surgical option there is variability in its reported outcomes for symptoms and re-intervention, with only some focus on satisfaction and little in the way of Australian studies. Haemorrhoids are a condition where symptoms are the predominant concern, once other insidious causes for presentation are excluded. Subsequently, our intention with haemorrhoid management should relate to patient satisfaction and symptom resolution or reduction. From our results we show that patients who undergo Doppler HAL achieve high satisfaction results with short and term medium satisfaction rates of 84% (65/77) and 88% (65/74) respectively.

Based on our experience, there was a significant improvement in post-operative care requirements compared to those initially expected. Length of stay and inconvenience will obviously play a role in the impact on the patient. Whilst primarily planning for patients to have an overnight hospital stay, following the first 18 cases performed between 2011 and 2012, the procedure was subsequently changed to day-only surgery. This was based on excellent patient reported symptoms with minimal post-operative oral analgesia requirements. This differs to many other procedures where there are longer hospital stays, delayed return to usual activities and significant analgesia requirements post-operatively [9].

Initial follow-up re-intervention was low at 8%, and re-intervention between 3-18 months was in line with the recent literature at 17 % [6]. The recently acquired medium term data indicates an increasing re-intervention rate, from 17% at 3-18 months to 32% beyond 18 months. Re-intervention was most commonly a RBL (9/74; 12%) or repeat Doppler HAL (7/74; 9%). These results regarding re-intervention were in keeping with previous reported rates, in particular we compared our results to a contemporary well powered randomized control trial (HubBle) published in the UK this year which examined RBL and HAL [16]. There was no significant difference in progressing to a subsequent procedure in the form of subsequent RBL (Z-Score 0.8307, $P=0.40654$, at $P<0.05$) or repeat Doppler HAL (Z-Score 1.5377, $P=0.12356$, at $P<0.05$).

The HubBle trial concluded that whilst HAL had lower recurrence rates there was increased post-operative pain and hence the simple yet repeated process of RBL may be preferable [18].

This study was performed on patients with grade II-III haemorrhoids with no history of prior surgery or RBL/injection within the past 3 years. Comparing our data to this we feel the outcomes are still satisfactory in light of the higher grade of patients treated. Furthermore, the vast majority of our patients had required a previous RBL (91%) compared to no previous intervention within 3

years. We questioned whether this may indicate that selection criteria has a role in predicting recurrence, although it has been previously established that HAL has the highest recurrence rate of all surgical interventions [11]. We feel that despite their conclusion regarding preference for RBL that our results continue to support Doppler HAL and it has a role to play as a non-excisional therapy. Doppler HAL provides a day surgery option requiring minimal post-operative analgesia and good symptom control and high patient satisfaction in the short and medium term. Furthermore, with multiple RBLs versus a single day procedure we should consider the convenience and embarrassment of being awake and alert during multiple office based procedures versus a single day-stay with a procedure under anaesthetic.

Few patients required major re-intervention to the extent of a Milligan-Morgan (4/74; 5%). Those that did require a Milligan-Morgan occurred within the first 18 months. One patient undergoing re-intervention was a patient who despite being happy with subsequent symptoms had an opportunistic RBL whilst undergoing a colonoscopy. There were no reported episodes of urinary retention, sepsis or major post-operative bleeding requiring re-admission, with the procedure appearing to be generally safe as a day only procedure. Comparing the different treatment options, RBL is cheap and potentially suitable as a treatment performed in a clinic setting; however, it has a high recurrence rate, ranging from 11% to over 50% and often requires repeat RBLs [9,12,13,19-22]. Milligan-Morgan haemorrhoidectomy has low recurrence rate but is known to have considerable post-operative discomfort and higher complication rates [9]. We see Doppler HAL as an alternative treatment option, which allows a quicker return to normal activity with minimal post-operative discomfort (compared to haemorrhoidectomy) and an efficacy better than RBL with less complications and pain compared to haemorrhoidectomy [9,11-13].

Whilst statistically there was no significant non-parametric correlation showing a learning curve, it is interesting to note that within the first 18 cases performed, four underwent repeat HALs that subsequently showed satisfactory results, possibly indicating some learning curve. We hope that as our experience with the procedure continues to produce results we may see improvement in outcomes.

There are some limitations to our study. The study size, whilst comparable to other publications of experience, is only modest. Furthermore, it was an initial experience, and as such will inevitably include a learning. Whilst there was no statistical difference in outcomes seen due to the learning curve, there was a change in practice from overnight stay to a day-only procedure. Another limitation of our study was partly in the way it conducted follow up. It was a single surgeon database and relied generally on telephone follow up, with additional information gathered opportunistically from any patient initiated attendance to the rooms. We believe that using telephone contact contributed to our high retention rate (97%), and that whilst patients had the opportunity to decline engagement with the survey they were given a non-confronting environment in which they could express their experience. Of course there was the possibility that patients might report being more satisfied than they truly were. In an attempt to avoid this survey was conducted by a third party, i.e. not the operating surgeon, although whether this changed patient's perception

of how their responses would be received was not determined. It must be subsequently noted that analysing patient satisfaction without anonymity may have induced social desirability bias.

Conclusion

HAL is a safe and effective treatment for patients suffering haemorrhoidal disease with primary symptom being haemorrhoidal bleeding. Symptomatic relief with excellent patient satisfaction of up to 88% can be achieved beyond 18 months whilst inflicting little post-operative discomfort and disruption to daily routines. There were no major complications. Whilst re-intervention rates remain higher than some alternative interventions a good result is expected from our centre as the Doppler HAL technique matures. This paper adds further information on short and medium term outcomes for grade III and IV haemorrhoids with regards to patient satisfaction, symptoms and re-intervention following Doppler HAL in Australia.

Conflicts of Interest

The authors have no conflict of interest to declare.

References

1. Ng KS, Nassar N, Hamd K, Nagarajah A, Gladman MA. Prevalence of functional bowel disorders and faecal incontinence: an Australian primary care survey. *Colorectal Dis.* 2015 Feb;17(2):150-159.
2. Trewhin D. Australian Bureau of Statistics. 2004-05 National health survey. Summary of results, Australia. Canberra: Australian Bureau of Statistics; 2006 Feb.
3. Bleday R, Pena JP, Rothenberger DA, Goldberg SM, Buls JG. Symptomatic hemorrhoids: current incidence and complications of operative therapy. *Dis Colon Rectum.* 1992 May;35(5):477-481.
4. Lohsiriwat V, Vongjirad A, Lohsiriwat D. Value of routine histopathologic examination of three common surgical specimens: appendix, gallbladder, and hemorrhoid. *World J Surg.* 2009 Oct;33(10):2189-93.
5. Australian Institute of Health and Welfare. National hospital morbidity database (NHMD) [Online database].
6. Canberra: Australian Institute of Health & Welfare; 2014 [cited 2016].
7. Separation statistics by principal diagnosis (ICD-10-AM 8th edition), Australia, 2013-14].
8. Loganathan A, Das A, Luck A, Hewett P. Transanal haemorrhoidal dearterialization for the treatment of grade III and IV haemorrhoids: a 3-year experience. *ANZ J Surg.* 2016 Jan-Feb;86(1-2):59-62.
9. Morinaga K, Hasuda K, Ikeda T. A novel therapy for internal hemorrhoids: ligation of the hemorrhoidal artery with a newly devised instrument (Moricorn) in conjunction with a Doppler flowmeter. *Am J Gastroenterol.* 1995 Apr;90(4):610-613.
10. Wilkerson PM, Strbac M, Reece-Smith H, Middleton SB. Doppler-guided haemorrhoidal artery ligation: long-term outcome and patient satisfaction. *Colorectal Dis.* 2009 May;11(4):394-400.
11. Simillis C, Thoukididou SN, Slesser AA, Rasheed S, Tan E, et al. Systematic review and network meta-analysis comparing clinical outcomes and effectiveness of surgical treatments for haemorrhoids. *Br J Surg.* 2015;102(13):1603-1618.
12. Dal Monte PP, Tagariello C, Giordano P, Cudazzo E, Shafi A, et al. Transanal haemorrhoidal dearterialisation: nonexcisional surgery for the treatment of haemorrhoidal disease. *Techniques in Coloproctology.* 2007 Dec;11(4):333-339.
13. Faucheron JL, Gangner Y. Doppler-guided hemorrhoidal artery ligation for the treatment of symptomatic hemorrhoids: early and three-year follow-up results in 100 consecutive patients. *Dis Colon Rectum.* 2008 Jun;51(6):945-949.
14. Infantino A, Bellomo R, Dal Monte PP, Salafia C, Tagariello C, et al. Transanal haemorrhoidal artery echodoppler ligation and anopexy (THD) is effective for II and III degree haemorrhoids: a prospective multicentric study. *Colorectal Dis.* 2010 Aug;12(8):804-849.
15. Ratto C, Donisi L, Parella A, Litta F, Zaccone G, et al. 'Distal Doppler-guided dearterialization' is highly effective in treating haemorrhoids by transanal haemorrhoidal dearterialization. *Colorectal Dis.* 2012 Nov;14(11):786-789.
16. Tsang YP, Fok KL, Cheung YS, Li KW, Tang CN. Comparison of transanal haemorrhoidal dearterialisation and stapled haemorrhoidopexy in management of haemorrhoidal disease: a retrospective study and literature review. *Tech Coloproctol.* 2014 Nov;18(11):1017-1022.
17. Felice G, Privitera A, Ellul E, Klaumann M. Doppler-guided hemorrhoidal artery ligation: an alternative to hemorrhoidectomy. *Dis Colon Rectum.* 2005 Nov;48(11):2090-2093.
18. Brown SR, Tiernan JP, Watson AJ, Biggs K, Shephard N, et al. Haemorrhoidal artery ligation versus rubber band ligation for the management of symptomatic second-degree and third-degree haemorrhoids (HubBLE): a multicentre, open-label, randomised controlled trial. *Lancet.* 2016 May;388(10042):356-364.
19. Tiernan J, Hind D, Watson A, Wailoo AJ, Bradburn M, Shephard N, et al. The HubBLE trial: haemorrhoidal artery ligation (HAL) versus rubber band ligation (RBL) for haemorrhoids. *BMC Gastroenterol.* 2012 Oct;12:153.
20. Peng BC, Jayne DG, Ho YH. Randomized trial of rubber band ligation vs. stapled hemorrhoidectomy for prolapsed piles. *Dis Colon Rectum.* 2003 Mar;46(3):291-297.
21. Shanmugam V, Thaha MA, Rabindranath KS, Campbell KL, Steele RJ, et al. Systematic review of randomized trials comparing rubber band ligation with excisional haemorrhoidectomy. *Br J Surg.* 2005 Dec;92(12):1481-1487.
22. Shanmugam V, Thaha MA, Rabindranath KS, Campbell KL, Steele RJ, et al. Rubber band ligation versus excisional haemorrhoidectomy for haemorrhoids. *Cochrane Database Syst Rev.* 2005 Jul;20(3).